Characterization of Concentrator Receivers by an Appropriate Solar Tester: System Development and Measurement procedure

V. Pérez[1], R. Herrero[1], M. Victoria[1], I. Antón[1], G. Sala[1], M. Carpanelli[2], G. Borelli[2], D. Verdilio[2], D. De Nardis[2], F. Migali[2], A. Antonini[3]

1- Instituto de Energía Solar – Universidad Politécnica de Madrid

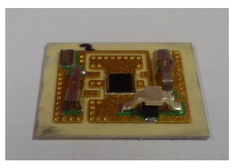
2- BECAR, Bologna, Italy

3-AUREL, Modigliana, Italy

OBJECTIVES

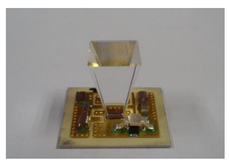
1. To evaluate electrical properties of concentrating receivers (solar cell and Secondary Optical Element (SOE)) by the system so called **CIRCE**
2. To present main characteristics of the developed equipment
3. Case-study: evaluation of the gluing process of SOE and cell

WHAT ARE THE DIFFERENCES BETWEEN THE MEASURING CONDITIONS NEEDED FOR CELLS AND RECEIVERS?



Multi-junction solar cell

- High irradiance (concentrated light)
- AM1.5D spectrum
- Lamertian illumination



Receiver (Multi-junction solar cell and SOE)

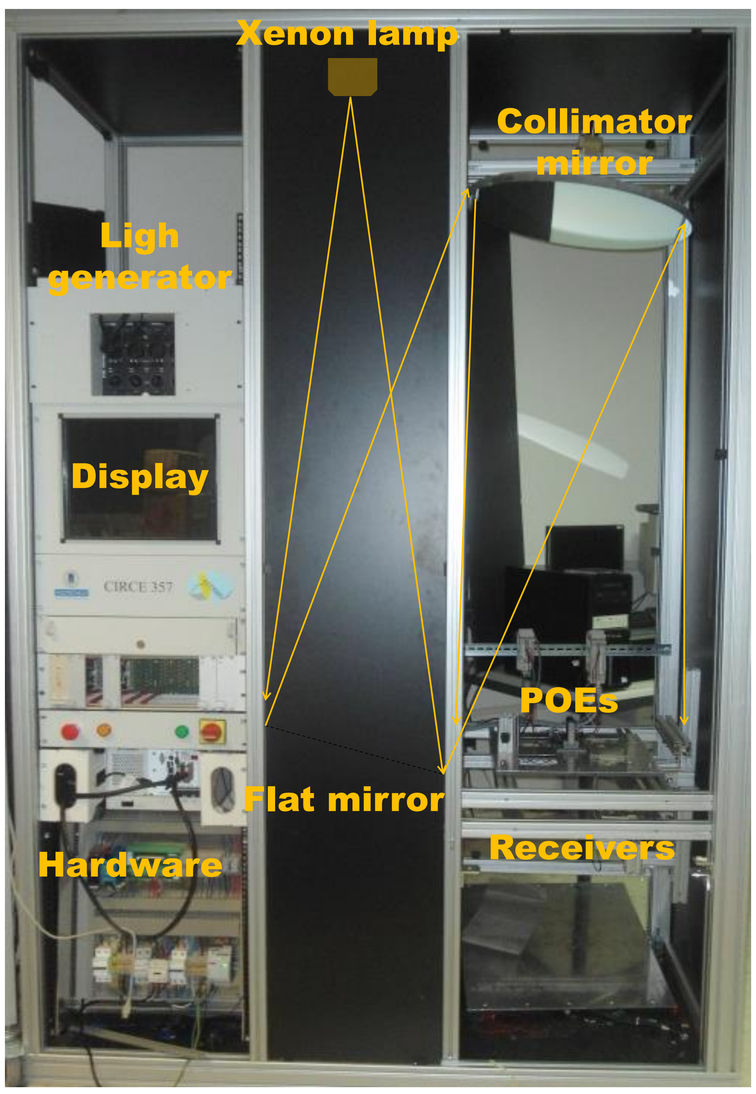
To reproduce the illumination of the Primary Optical Element (POE):

- Modified AM1.5D spectrum (at the entrance of the receiver)
- Non-uniform profiles and angular distribution (at the entrance of the receiver)

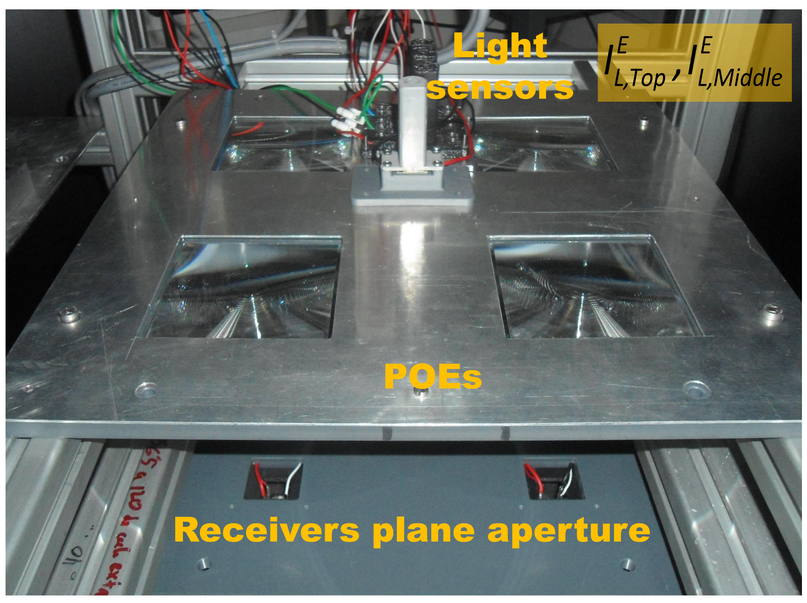
→ **CIRCE**

CIRCE: AN APPROPRIATE SYSTEM TO CHARACTERIZE ELECTRICAL PROPERTIES OF RECEIVERS

CIRCE system has been developed at the IES-UPM and transferred to the company Solar Added Value (SAV) for commercialization.



Collimated light at the entrance of Primary Optical Elements (POEs) is produced by a Xenon flash lamp a flat mirror and a collimator mirror



Four receivers are measured in parallel (in a single light pulse) while illuminated by four POEs

Spectral Matching Ratio

$$SMR = \frac{I^E_{L,Top} / I^E_{L,Middle}}{I^{AM1.5D}_{L,Top} / I^{AM1.5D}_{L,Middle}}$$

Calibration constants

The light spectrum is controlled by component reference cells (isotypes) to have an equivalent AM1.5D spectrum (SMR=1) at the POEs entrance

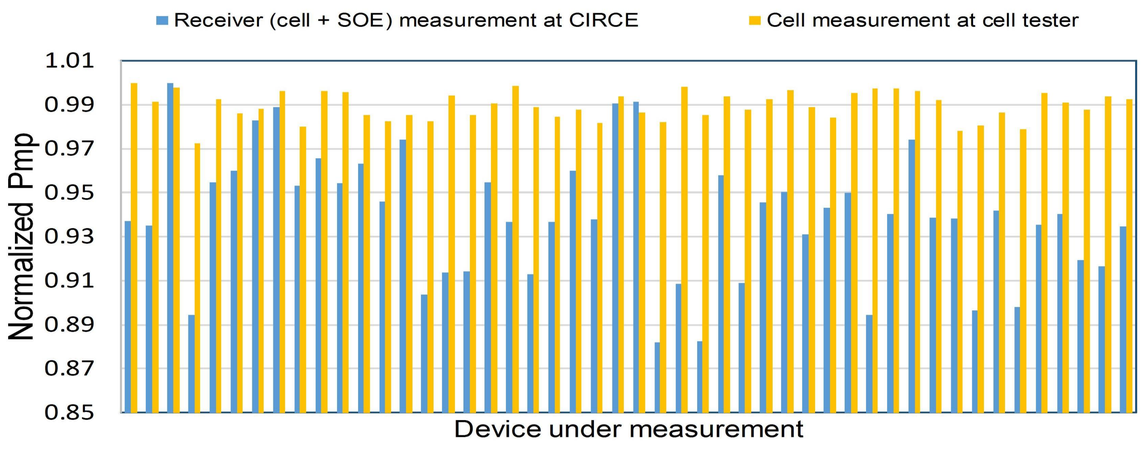
CIRCE system may be included into a production line

Irradiance (POEs entrance) ($W \cdot m^{-2}$)	1000
Spectral Matching Ratio (SMR)	1 ±2%
Angular size (POEs entrance) (deg)	±0.3
Light uniformity (POEs entrance) (%)	±2.5
Measurement time for IV curve (μs)	300
Repeatability (%)	1

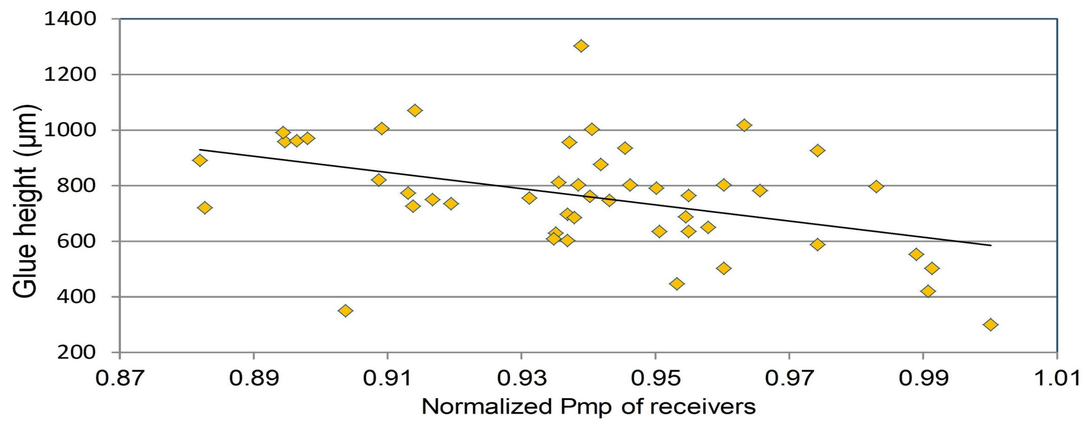
Main characteristics of CIRCE

CASE-STUDY: EVALUATION OF GLUING PROCESS OF SOE AND CELL

Receivers manufactured by AUREL to be installed into BECAR modules have been characterized by the CIRCE system



The lower the glue height the better the receiver performance (lower losses due to spilling light beyond the cell perimeter)



CONCLUSIONS

CIRCE system is appropriate to perform a quality control of receivers in production line before being installed in a CPV module